
Mimicking Cartilage Tissue Zonal Organization by Engineering Tissue-Scale Gradient Hydrogels as 3D Cell Niche.

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Public Summary:

Zonal organization plays an important role in cartilage structure and function, whereas most tissue-engineering strategies developed to date have only allowed the regeneration of cartilage with homogeneous biochemical and mechanical cues. To better restore tissue structure and function, there is a strong need to engineer materials with biomimetic gradient niche cues that recapitulate native tissue organization. To address this critical unmet need, in this study, we report a method for rapid formation of tissue-scale gradient hydrogels as a three-dimensional (3D) cell niche with tunable biochemical and physical properties. When encapsulated in stiffness gradient hydrogels, both chondrocytes and mesenchymal stem cells demonstrated zone-specific response and extracellular deposition that mimics zonal organization of articular cartilage. Blocking cell mechanosensing using blebbistatin abolished the zonal response of chondrocytes in 3D hydrogels with a stiffness gradient. Such tissue-scale gradient hydrogels can provide a 3D artificial cell niche to enable tissue engineering of various tissue types with zonal organizations or tissue interfaces.

Scientific Abstract:

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